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NIST Support of the CALS Program: 1990 Synopsis

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**U.S. DEPARTMENT OF COMMERCE
Robert A. Mosbacher, Secretary
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John W. Lyons, Director**

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UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

Computer Systems Laboratory

June 14, 1991

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From: Sharon J. Kemmerer *SK*
Information Systems Engineering Division

Subject: NIST CALS Deliverables Presented to the DoD CALS Office

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Industry Steering Group
ISG Task Force Chairs
CALS Test Network Review Board
Janet Geffner, NTIS

cc: David Jefferson, NIST CALS Program Manager

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NIST SUPPORT OF THE CALS PROGRAM:

1990 SYNOPSIS

ABSTRACT

This report summarizes overall CALS Program management, technical support, and administration provided by NIST. A 1990 précis is offered in each of the general technical support areas: electronic data interchange, graphics, document standards, raster compression, data management, security, and data communication. Most of the NIST deliverables given to the CALS Office have since been published for easier access by the CALS community. This report offers the titles and brief abstracts of such published deliverables, as well as titles and abstracts for those NIST CALS deliverables published in previous years.

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EXECUTIVE SUMMARY

The Computer-aided Acquisition and Logistic Support (CALS) Program has a goal to accelerate the development and deployment of technology that will result in higher quality, shorter time to production, and lower costs for both weapon systems and commercial products. Efforts associated with this initiative have been ongoing since 1985, when the Department of Defense (DoD) established the CALS Program. The National Institute of Standards and Technology (NIST) under the Department of Commerce (DoC) has worked with the CALS Office since the Program's commencement. DoD and DoC share a common interest in enterprise integration through the digital sharing of technical data among trading partners, using existing and evolving international and national standards and specifications.

This report is a summary of the published deliverables,¹ and the technical and administrative support provided the CALS Office during 1990. A list of NIST CALS deliverables published in previous years is also included at the end. This report focuses on work other than that which has been done under the development and management of the Product Data Exchange Network as carried out by the NIST National PDES² Testbed (NPT). Reports on NPT efforts can be found under separate cover.

"CALS: The Time is Now!" was the theme for the 1990 CALS Expo. In resonance with this theme, DoD and DoC³ felt it was appropriate to establish a formal Memorandum of Understanding (MoU). This action elevated the visibility of the CALS Program and PDES activities within the Department of Commerce, from NIST, to the next higher level, DoC Technology Administration; however, NIST still remains the primary technical support arm to the CALS Office. The primary areas of joint focus established under this MoU are: (1) DoC support of DoD to develop, test, and implement standards for the digital interchange of technical data in support of the CALS

¹ The publishing of this collection of reports does not imply the CALS Office has endorsed the conclusions or recommendations presented.

² PDES - Product Data Exchange using STEP (STandard for the Exchange of Product model data)

³ This MoU was signed by Mr. Colin McMillan, DoD Assistant Secretary of Defense for Production and Logistics and Dr. Robert White, DoC Under Secretary for Technology.

Program, while helping to ensure that DoD CALS is aligned with industry trends; and (2) both agencies will jointly undertake a program to develop, test, and implement standards for product data exchange.

NIST has been contributing toward these mutual endeavors over the last several years. The following is a brief summary of some of the activities associated with the various technical areas in which DoC/NIST supported the CALS Office during 1990. The broad category designations are taken directly from the statement of work. These categories have been an easy way to manage the project, although there may be an activity under one category which may seem more logical under another category.



Electronic Data Interchange (EDI).

After performing a detailed analysis of the American National Standards Institute (ANSI) X12 standards, NIST contributed the EDI transaction set for Milstd-1840B inclusion, based on the draft standard developed by ANSI X12. Ongoing representation occurred at X12 committee meetings, as well as participation in working groups of the North American Integrated Services Digital Network (ISDN) Users' Forum to produce an EDI application profile and implementors' agreement for EDI Applications on ISDN. ISDN is envisioned to be a viable solution for transferring large volumes of technical data across communication lines.



Graphics Standards.

Computer Graphics Metafile (CGM).

Continued effort was made in the CGM national and international standards organizations to increase applicability in CALS. This has led to updating the CGM application profile which will undergo 1991 processing as Mil-D-28003A. In addition, the executable test suites were developed to check for conformance of data files to Mil-D-28003 and FIPS 128.

Initial Graphics Exchange Specification (IGES).

While transitioning the technical work of Mil-D-28000 to a lead DoD service activity, NIST provided consulting support for Mil-D-28000A development and reviewed CALS test plans developed to support the testing of Mil-D-28000. CALS funding also contributed toward NIST's leadership role in developing the first IGES application protocol to be delivered to industry. It is an important example for the development of STEP application protocols.



Documents.

During the first part of 1990, NIST provided resources to work with government and industry representatives to publish the new version of 28001, Mil-M-28001A. NIST also participated in the OSI Implementor's Workshop Office Document Architecture (ODA) Special Interest Group (SIG) representing Mil-M-28001 requirements, while attempting to harmonize SGML and ODA in overlapping functional areas. As part of this harmonization activity, a workshop was sponsored at NIST to help gain a common level of understanding and to define the requirements and issues. To serve as a model for a common government application encoded in both SGML and ASN.1, an SGML/ASN.1 profile was developed.



Data Management.

NIST documented CALS data dictionary criteria, evaluated DoD and industry data dictionaries/directories against those criteria, and described the desired outcome in a summary level matrix. The purpose was to provide a technical framework so functional efforts could develop data dictionaries and data directories. In addition, we offered a standards perspective while DoD developed the specifications for the Contractor Integrated Technical Information Services (CITIS). While advising on standards options, DoD advised on necessary requirements for such standards to work, and NIST represented those requirements through the national and international standards committees. NIST recommendations included such standards as the Information Resource Dictionary System (IRDS), Database Language SQL, and Remote Database Access (RDA).



Security.

NIST supported the National Security Industrial Association (NSIA) CALS Industry Steering Committee Security Subgroup and the Quick Reaction Task Order (QRTO) Risk Assessment TAG (Technical Advisory Group) with technical expertise in security. NIST also investigated public key cryptography appropriate for the calculation of digital signatures and for the distribution of secret keys, e.g., keys used by the Data Encryption Standard (DES) algorithm.



Raster Graphics.

While continuing the ongoing efforts of support for Mil-R-28002A publication, NIST also advanced the use and value of Type I and Type II. Conformance testing procedures were recommended for Type I, and a beta test was established for testing raster files under the DSREDS/EDCARS/EDMICS/CTN programs. NIST also monitored and coordinated the ANSI and International

Organization for Standardization (ISO) processing of the Tiling addendum through the ODA committees.



Data Communications.

NIST continued to advise the CALS Office to help ensure CALS communications standards will be interoperable with appropriate future industry standards. NIST contributed to changes in CALS documents relating to GOSIP, reviewed CALS documents and specifications developed by the CALS Telecommunications Working Group, and delivered presentations at CALS workshops as required.

NIST contributed extensive administrative support throughout the year for the CALS Office and Industry Steering Group (ISG) activities. Included in some of this support: continual update and maintenance of a 7,000+ address database which embodies all the CALS contacts for CALS DoD and CALS ISG interactions, mailings, and requests for information; coordinating the CALS military specifications, standards, and handbook commenting cycle, reconciliation meetings, publication, and dissemination; providing thousands of hard copies and electronic copies of CALS reports, publications, and specifications on an as-called basis; and maintaining the CALS bulletin board --- a communication vehicle for information dissemination, electronic copies of specifications, and one-to-one or conference level exchange.

NIST CALS Program management and technical planning are handled centrally in the Computer Systems Laboratory. This office supplied internal oversight over the technical and administrative tasks mentioned above, as well as gave management assistance to the CALS Office. This past year, NIST provided a full-time resource to the CALS Office to support day-to-day activities and to provide a perspective on the business aspects of CALS. Other managerial projects included: awarding and administering the tasks under the Quick Response Task Order contract; advising on Small Business concerns, Industry Modernization Incentive Program (IMIP), cost accounting and billing issues, CITIS concerns, acquisition issues, CALS/CIM incentives, and technology transfer; and reviewing technology to assess the correctness of the overall direction of CALS efforts, providing recommendations to the CALS Office on new opportunities.

In preparation for the end-of-year CALS Expo '90 hosted in Dallas, Texas, December 3-6, NIST provided representation and support to the Expo Planning Committee. Other NIST staff took part as session chairs and session speakers during the event, covering such topics as application protocols, conformance testing, and standards-related activities. NIST also furnished and staffed a "DoC for Technology Administration and NIST" booth. Demonstrations during the week included navigating through a draft of STEP using hypertext technology, and showing how the CGM and GKS conformance

test suites work. In addition, multiple handouts were available for those who visited our booth: an optical disk to demonstrate hypertext using various versions of IGES and STEP text; CALS 1990 video tape; CALS deliverables on application programmer's interface standards; and status update sheets on several of the conformance testing services for the graphics standards and Database Language SQL.

ACKNOWLEDGEMENTS

In addition to those authors listed on the following pages, many others at NIST have participated technically and administratively in the many ongoing CALS activities. Their support efforts are often behind the scenes contributing to the total picture, invisible to the public.

The following is an alphabetical list of these contributors:

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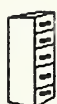
PUBLICATIONS

Publications.⁴



Benigni, Daniel R., ed., NIST Support for the Computer-aided Acquisition and Logistic Support (CALS) Program in the Area of Graphics Standards, Calendar Year 1990, NISTIR 4579, May 1991.

This report summarizes the continuing work of the NIST Graphics Software Group in support of the CALS Program for CY90. The content of this report consists of the separate deliverables as developed by the NIST Graphics Software Group for CY90. Completed tasks reflected in these deliverables include: (1) update CGM Application Profile (i.e., update Mil-D-28003); (2) inject CALS requirements into the standards committees' work on amendments to the CGM standard; (3) produce a software tool to determine conformance of a metafile to the CGM standard and to Mil-D-28003; and (4) explore potential sources of generator and interpreter conformance testing capabilities.



Gallagher, Leonard, SQL3 Support for CALS Applications, NISTIR 4494, December 1990.

Previous reports to CALS have identified the importance of Database Language SQL in CALS Phase II requirements. This report focuses on SQL3, a follow-on standardization project for major SQL enhancements that is expected to be adopted by ANSI, ISO, and as a FIPS in the mid 1990's. Many of the proposed SQL3 features are of particular importance to STEP because of that standard's unique data modeling and data access requirements. Existing and planned features in SQL3 may not satisfy all STEP requirements, but they should provide an appropriate base from which many requirements can be suitably addressed. This report identifies the major enhancements under consideration by the ANSI and ISO SQL standardization committees and relates them to known STEP requirements. It also discusses the status of these features in the SQL3 specification and indicates opportunities available to CALS to influence further development.

⁴ The icons preceding these CALS deliverables cross-reference to the broad categories as defined in the Executive Summary.



Jefferson, David K., A Framework for Developing a CALS Data Dictionary, NISTIR 4377, July 1990.

This paper provides guidance for the development of data dictionaries for the Computer-aided Acquisition and Logistic Support (CALS) Program. The objective is to present the costs and benefits of alternative architectures; five levels of service are analyzed. Six steps are recommended for data dictionary development and a brief tutorial on data dictionaries is included.



David K. Jefferson and Cita M. Furlani, Use of the IRDS Standard in CALS (revised), NISTIR 89-4169, November 1990.

The objective of this point paper is to show how the Information Resource Dictionary System (IRDS) can fulfill critical design and operational requirements for CALS Phase II. Based on a series of assumptions made about the data management services needed by Phase II, a series of requirements for a data dictionary are developed. The structure of the IRDS family of standards is described and examples given on how the IRDS could meet the specified requirements. A schedule is presented to illustrate that the IRDS and other data management standards will be available when needed to meet the requirements of CALS. An architecture is presented to identify additional standards necessary to meet longer range goals of distributed database management.



Nectaval, James, Public-Key Cryptography, Special Publication 800-2, April 1991.

This publication presents a state-of-the-art survey of public-key cryptography circa 1988-1990. In doing so, it covers a number of different topics including: the theory of public-key cryptography, comparisons to conventional (secret-key) cryptography, a largely self-contained summary of relevant mathematics, a survey of major existing public-key systems, an exploration of digital signatures and hash functions, a survey of public-key implementations in networks, an introduction to zero-knowledge protocols and probabilistic encryption, and an exploration of security issues and key sizes.



Mark E. Palmer and Kent A. Reed, 3D Piping IGES Application Protocol Version 1.0, NISTIR 4420, September 1990.

The 3D Piping IGES Application Protocol (AP) specifies the mechanisms for defining and exchanging 3D piping system models in IGES format. The AP defines three-dimensional arrangement data of piping systems which includes definition data types of geometry (shape and location), connectivity, and material characteristics. The specified piping model is sufficiently detailed to support the fabrication and final assembly of a piping system.



Sies, Roger, Government Document Processing Requirements Report, NISTIR 4560, April 1991.

This report describes several activities of the Office Systems Engineering Group in the area of electronic publishing standards. It gives an account of the July 30, 1990, workshop on "Electronic Information Exchange Standards Used in Document Processing Applications" and the list of user requirements that came out of that workshop. The report also discusses other efforts the Office Systems Engineering Group has made to help bring about the harmonization of electronic publishing standards.



Spielman, Frankie, Raster Graphics Conformance Testing, NISTIR 4524, March 1991.

This publication is a report which evaluates the alternatives for identifying and selecting a conformance testing laboratory for raster graphics in support of the CALS Program military specification, Mil-R-28002. It discusses and analyzes four different approaches to selecting a conformance testing laboratory. After discussing the approaches, it recommends an alternative for DoD to pursue in selecting a laboratory for conducting conformance testing of raster graphics implementations. The annexes to the report describe the requirements, procedures, forms, and criteria necessary for establishing and managing a raster graphics conformance testing program.



Wilson, Ronald, A Standard Generalized Markup Language Encoding of the Office Document Architecture Document Application Profile, NISTIR 4547, March 1991.

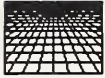
This report describes in various levels of detail the two international standards, SGML and ODA. It then discusses, by offering a simple example, the methodology involved in performing an SGML encoding. Subsequently, it examines the SGML encoding of the ODA DAP. The report provides two accompanying tables with the SGML encoding and finishes with a brief summary of the two standards.

The above publications are available for purchase through the National Technical Information Service (NTIS), Springfield, VA 22161. Telephone orders can be made by calling 703/487-4650.

Military Specifications.



Mil-R-28001A, Manuals, Technical: Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange, 20 July 1990.



Mil-R-28002A, Raster Graphics Representation in Binary Format, Requirements for, 30 November 1990.

The above military specifications are available in electronic form through the CALS Bulletin Board via phone: 301/948-8966, or Telnet: calsbbs.cme.nist.gov.

Unpublished Deliverables.

The following documents were presented to the CALS Office as part of the requirements under the statement of work, but are not expected to be published in their current state. In some cases, additional standardization or coordination is required prior to publication.



Advanced Systems Division, "ISDN Procurement Guideline Part I - Migration Strategy," Draft, November 1990.

The purpose of this document is to provide guidance in strategic planning for, and acquisition of, ISDN services and equipment. The objective is to provide information and methods which can be used to facilitate multi-vendor procurements. Extensive reference is made to national and international standards, and to the forthcoming implementation agreements and conformance criteria of the North American ISDN Users' Forum. Background information is given on issues pertaining to ISDN in order to assist the telecommunications planner in assessing the state of the market, possible evolutions in the market, and specific undertakings and requirements for ISDN implementation.



Roy G. Saltman, David H. Su, and Douglas R. White, "Transmission of Technical Information Specified in Mil-Std-1840A Through the Use of X12 EDI Transaction Set 841," Draft, October 1990.

This report first introduces the concept of the X12 EDI transaction set, it then reviews the progress in the development of Transaction Set 841 for Specification/Technical Information by the ANSI X12 Product Data Project team. A proposal on how this transaction set could be used for transmission of MIL-STD-1840A data in an EDI environment is presented.

The above documents may be obtained through Dr. David Su, National Institute of Standards and Technology, Materials, Room B364, Gaithersburg, MD 20899.



ASC X12E/TG2/90-738, "Draft Standard for Trial Use for Electronic Data Interchange Specifications/Technical Information Transaction Set (841)," Version 003, Release 010, X12.51 - October 1990.

This Draft Standard for Trial Use contains the format and data contents of the Specifications/Technical Information Transaction Set (841) for use within an Electronic Data Interchange (EDI) environment. This transaction set provides for the exchange of complete or partial specifications of technical information, and other information related to products and services, between trading partners.

The above document may be obtained through Secretariat, ASC X12, Data Interchange Standards Association, 1800 Diagonal Road, Suite 355, Alexandria, VA 22314-2852.

ADDITIONAL SERVICES

Technical publications and status reports are only one way in which NIST assists the CALS Office. The tasks that follow will give the reader a flavor for the many support functions in which NIST participates to represent CALS interests, and the level of effort required to provide the best deliverable at the culmination of such activity.

Continue to track work being done by ANSI X12 Product Specifications Working Group, and participate in the group's meetings as required.

Work with working groups of the North American ISDN Users' Forum to produce an EDI Application Profile and Implementors' Agreement for EDI Applications on ISDN.

Provide consulting services to David Taylor Research Center (DTRC) and coordinate input to test plan as required.

Liaise between DTRC and other national and international IGES testing activities.

Review and evaluate DTRC test plan and other deliverables.

Update CGM Application Profile (AP).

Inject CALS requirements into CGM Addenda.

Attend meetings of the CITIS TAG.

Provide briefings, point papers, etc., to CITIS contractor and TAG, as well as other interested members of the CALS community.

Work with SQL committee to inject CALS requirements into SQL3 and RDA.

Support the NSIA CALS Industry Steering Committee Security Subgroup and the QRT0 Risk Assessment TAG with technical expertise in the area of security. Participate in meetings, review documents, and formulate longer-term strategy.

Update raster standards as required based on the EDMICS implementation experience.

Revise the Document Application Profile to include an example and provide a more self-contained document.

Monitor and coordinate ANSI/ISO processing of the Raster Tiling addendum.

Develop MIL-R-28002 Type 1/II conformance testing capability. Support the CTN and Services in prototyping this capability, and in the system acceptance testing for DSREDS/EDCARS and EDMICS.

Contribute to changes to CALS documents relating to GOSIP, review CALS documents and specifications developed by the CALS Telecommunications Working Group, and deliver presentations at CALS workshops as required.

Prepare Milstds and Milspecs for CALS-related areas. Provide administrative coordination and technical support. Perform structural formatting.

Complete coordination, revision, and publication of Milstds and Milspecs for CALS-related areas.

Attend meetings, maintain and upgrade CALS Bulletin Board, and respond to phone and mail requests for information, references, and documents.

Arrange meetings as required for the conferences, workshops, DoD and Industry Steering Group committees, CALS Test Network Review Board, CALS contract TAGs, etc. Provide technical and administrative assistance to the meetings as required.

Award and administer tasks under QRT0 contract.

Provide assistance to OSD program planning.

Represent CALS Office at meetings and conferences.

Review and coordinate CALS testing programs.

Manage business aspects, including small business concerns, IMIP, cost accounting and billing issues, CITIS concerns, acquisition issues, CALS/CIM incentives, and technology transfer.

Conduct research into the technologies now emerging and expected to emerge which may be applicable to the CALS Program. Investigate such technologies to the extent needed to determine their usefulness and to define the course and timing of development needed to support CALS. Define technology development which may not be apparently forthcoming but which may be needed to implement medium and long-range CALS functionality.

Identify current and emerging technologies which may be applicable to the CALS Program. Remain informed in their development and status. Evaluate them for applicability and usefulness in CALS. Advise CALS Program personnel of relevant developments.

Conduct program planning to ensure that current and emerging technologies are applied to the CALS Program. Prepare point papers showing how such technologies as artificial intelligence, object oriented languages, distributed data management methodologies, computer assisted software engineering and architecture development technology may be applied. Define the points in the CALS Program at which applicable technologies are to be introduced, and the impact on current and future planning. Provide timely input to the CALS planning process to permit informed planning and decision making with respect to the subject technologies.

CHAPTER 10: THE HISTORY OF THE UNITED STATES

The following table shows the population of the United States in 1790, 1800, 1810, 1820, 1830, 1840, 1850, 1860, 1870, 1880, 1890, 1900, 1910, 1920, 1930, 1940, 1950, 1960, 1970, 1980, 1990, and 2000.

Year	Population
1790	3,929,260
1800	3,929,260
1810	3,929,260
1820	3,929,260
1830	3,929,260
1840	3,929,260
1850	3,929,260
1860	3,929,260
1870	3,929,260
1880	3,929,260
1890	3,929,260
1900	3,929,260
1910	3,929,260
1920	3,929,260
1930	3,929,260
1940	3,929,260
1950	3,929,260
1960	3,929,260
1970	3,929,260
1980	3,929,260
1990	3,929,260
2000	3,929,260

PUBLICATIONS FROM PREVIOUS YEARS

1986.

Kemmerer, Sharon J., ed., Final NBS⁵ Report for CALS, FY86, NBSIR 87-3566, May 1987.

This document is a compilation of reports presented to the CALS Office during 1986. Included in these reports are: a description of IGES standardization and testing activity; graphics standards introduction and assessment of DoD needs for computer graphics standards; a discussion on SGML Conformance Testing Methodology and Framework; and a preliminary report on data management standards.

1987.

A Collection of Technical Studies Completed for the Computer-aided Acquisition and Logistic Support (CALS) Program, Fiscal Year 1987, March 1988.

Kemmerer, Sharon J., ed., NBSIR 88-3726, Volume 1 of 4: This volume focuses on several areas: textual standards and associated activities; data management standards and supporting logistic support analysis using the Information Resource Dictionary System (IRDS); recommendations on optical disk media and interface requirements as they pertain to the EDMICS Procurement; using a tiled raster compression interchange format; and conformance testing introduction and requirements associated with CALS.

Kemmerer, Sharon J., ed., NBSIR 88-3727, Volume 2 of 4: This volume concentrates on various aspects of graphic interchange and presentation. Reports include: a state-of-the-art assessment of raster-to-vector conversion; development of CGM validation routines; a CALS application profile for CGM; CALS requirements reflected in the Extended CGM (CGEM) standards effort; a reference implementation for CGM; and an IGES-to-CGM translator design specification.

Kemmerer, Sharon J., ed., NBSIR 88-3728, Volume 3 of 4: This volume exclusively covers activities and recommendations associated with CGM registration to reflect CALS requirements.

⁵ NBS - National Bureau of Standards was the name prior to NIST.

Wright, Thomas, ed., NBSIR 88-3729, Volume 4 of 4: This volume presents guidelines for testing IGES translators and guidelines for developing an IGES application subset.

1988.

Morgan, Roy S., ed., A Collection of Technical Studies Completed for the Computer-aided Acquisition and Logistic Support (CALS) Program, Fiscal Year 1988, April 1990, Issued March 1991.

NISTIR 4315, Volume 1 of 3: This volume primarily covers the delivery of documents in digital form, security, and data management. Some of the topics include: text and graphics standards in the CALS publishing environment; ODA/ODIF application guidance and an ODA/ODIF conformance test plan; a page description language technology assessment; a standard page description language conformance strategy; a guide to the selection and use of risk assessment tools; computer security issues in the application of new and emerging information technologies; IRDS as an integration mechanism for product data exchange specification; and using the IRDS for PDES.

NISTIR 4316, Volume 2 of 3: This volume covers some graphics deliverables and includes such reports on CGM conformance testing, the final phase of Milspec CGM development, and planning for extending the CGM Milspec.

NISTIR 4317, Volume 3 of 3: This volume is devoted to identifying the CALS requirements for CGM registration and the current status of the registration activities.

1989.

Benigni, Daniel R., ed., Graphics Standards in the Computer-aided Acquisition and Logistic Support (CALS) Program, Fiscal Year 1989, Volume 1: Test Requirements Document, Extended CGM (CGEM), NISTIR 4329, May 1990.

This volume specifies test requirements for CALS CGM conforming basic metafiles and how to inject CALS requirements in the CGEM standards work.

Benigni, Daniel R., ed., Graphics Standards in the Computer-aided Acquisition and Logistic Support (CALS) Program, Fiscal Year 1989, Volume 2: Mil-D-28003 Revisions, CGM Registration, NISTIR 4330, May 1990.

This volume addresses Mil-D-28003 revision recommendations and CGM registration activities in support of CALS requirements.

Sharon J. Kemmerer and Mark W. Skall, Graphics Application Programmer's Interface Standards and CALS, NISTIR 89-4199, October 1989.

The principal purpose of a graphics Application Programmer's Interface (API) standard is to provide portability for an application program across a wide range of computers, operating systems, programming languages, and interactive graphics devices. This report provides background information on past graphics API recommendations, introduces the concepts of an API, and recommends to the CALS Office the utility of API graphics standards. The primary focus is on the two standards of interest to CALS: Programmer's Hierarchical Interactive Graphics System (PHIGS), and Programmer's Imaging Kernel (PIK), describing CALS applications for these standards.

The above publications are available for purchase through the National Technical Information Service (NTIS), Springfield, VA 22161. Telephone orders can be made by calling 703/487-4650.

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			8. TYPE OF REPORT AND PERIOD COVERED	
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10. SUPPLEMENTARY NOTES				
11. ABSTRACT (A 200-WORD OR LESS FACTUAL SUMMARY OF MOST SIGNIFICANT INFORMATION. IF DOCUMENT INCLUDES A SIGNIFICANT BIBLIOGRAPHY OR LITERATURE SURVEY, MENTION IT HERE.) This report summarizes overall CALS program management, technical support, and administration provided by NIST. A 1990 precis is offered in each of the general technical support areas: electronic data interchange, graphics, document standards, raster compression, data management, security, and data communication. Most of the NIST deliverables given to the CALS Office have since been published for easier access by the CALS community. This report offers the titles and brief abstracts of such published deliverables, as well as titles and abstracts for those NIST CALS deliverables published in previous years.				
12. KEY WORDS (6 TO 12 ENTRIES; ALPHABETICAL ORDER; CAPITALIZE ONLY PROPER NAMES; AND SEPARATE KEY WORDS BY SEMICOLONS) CALS; CGM; EDI; IRDS; ODA; security; SGML; STEP				
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